

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

REC'D 05 MAR 2004

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Applicant's or agent's file reference SCG/FP6125181	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/IB 03/00510	International filing date (day/month/year) 15.01.2003	Priority date (day/month/year) 15.01.2002
International Patent Classification (IPC) or both national classification and IPC G02B21/00		
Applicant ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 8 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

 These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:
 - I ☒ Basis of the opinion
 - II ☐ Priority
 - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV ☐ Lack of unity of invention
 - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI ☐ Certain documents cited
 - VII ☐ Certain defects in the international application
 - VIII ☐ Certain observations on the international application

Date of submission of the demand 13.08.2003	Date of completion of this report 02.03.2004
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Windecker, R Telephone No. +49 89 2399-7094 

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/IB 03/00510**

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-13 as originally filed

Claims, Numbers

1-19 received on 22.12.2003 with letter of 22.12.2003

Drawings, Sheets

1/3-3/3 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/IB 03/00510**

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	
	No: Claims	1-6,8-16
Inventive step (IS)	Yes: Claims	
	No: Claims	7,17-19
Industrial applicability (IA)	Yes: Claims	1-19
	No: Claims	

2. Citations and explanations

see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/IB03/00510

Item I:

Reference is made to the following documents, cited in the International Search Report:

- D1:** EP-A-0 916 981 (MAX-PLANCK-GESELLSCHAFT) 19 May 1999 (1999-05-19)
D2: US-A-4 584 484 (HUTCHIN) 22 April 1986 (1986-04-22)
D3: WO 98 45745 A (ISIS INNOVATION LIMITED) 15 October 1998 (1998-10-15)
D4: EP-A-1 065 809 (CSEM) 3 January 2001 (2001-01-03)
D5: STOKSETH: 'Properties of a Defocused Optical System' JOURNAL OF OPTICAL SOCIETY OF AMERICA, vol. 59, no. 10, 1969, pages 1314-1321, XP001149947
D6: VERVEER: 'Theory of confocal fluorescence imaging in the programmable array microscope (PAM)' JOURNAL OF MICROSCOPY, vol. 189, no. 3, March 1988 (1988-03), pages 192-198, XP001159711

Moreover, to

- D7:** US-A-5 867 604 (BEN_LEVY) 2 February 1999 (1999-02-02)

Item V:

1 Remarks on Novelty and Inventive Step (Art. 33 PCT):

1.1 The subject-matter of independent apparatus **claim 11** is not novel over document **D1** (=EP-A-0916981) for the following reasons:-

D1 discloses a microscopy imaging apparatus (figure 1); comprising:-

- illumination means 110, 111, 120, 133, 132 for illuminating a specimen 142 with a temporally modulating, spatially periodic illumination pattern (col. 7, line 25-33);
- imaging means 130, 140, 151, 152 for imaging said specimen 142 on a conjugate image plane (col. 7, line 33-39);
- acquisition means 150, 160 for acquiring a plurality of signals at respective positions on said image plane, each signal corresponding to the incident light intensity at that position and having an oscillatory component caused by the modulating illumination pattern (paragraph

- [0020]); and
- processor means for measuring a characteristic of the oscillatory component of each of the signals, whereby the measured characteristics when combined in their relative positions generate an optically sectioned image of the specimen (paragraph [0020]).

Hence, the microscopy imaging apparatus of **D1** has all the technical features recited by present **claim 11** which cannot therefore be regarded as defining novel subject-matter in the sense of Art. 33(2) PCT.

- 1.2 Present **claim 11** is also not novel over document **D3** (=WO-A-9845745) which was already cited in the description.

D3 discloses illumination means 10, 12, 14, 15 for illuminating a specimen **O** with a temporally modulating, spatially periodic illumination pattern. Although, the three images for the data acquisition are generated in a step-wise process by acquiring data images in which the mask is shifted by 120°, this process is also a temporal modulation of the illumination pattern, because these images are captured consecutively in a given time interval.

Imaging means 11, 12 are used to image said specimen **O** on a detector 13, acquisition means 13 acquire a plurality of signals at respective positions on the image plane, wherein each signal corresponds to the incident light intensity at that position having an oscillatory component caused by the phase-shifted-modulated illumination pattern, and processor means 16 measure a characteristic of the oscillatory component of each of the signals (each pixel has an oscillatory component due to the phase shift), whereby the measured characteristics when combined in their relative positions generate an optically sectioned image of the specimen (abstract and figure 1 with its corresponding text).

Hence, also the microscope of **D3** has all the structural features as defined by **claim 11** which cannot therefore be regarded as defining novel subject-matter in the sense of Art. 33(2) PCT.

- 1.3 Even a more restrictive interpretation of the term "temporally modulated" in

claim 11 in the sense that the mask is not stopped during the data acquisition could not be regarded as involving an inventive step in the sense of Art. 33(3) PCT.

In the field of phase shifting data acquisition techniques for interferometric set-ups (in which the data processing algorithm of **D3** falls), is a particular method known for increasing the data acquisition speed. In this method the fringes are moved with a constant velocity during the data acquisition with the camera and the sampling interval is determined only by the integration time of the CCD camera.

An ordinary skilled person would certainly apply this well known technique to reduce the acquisition time of his microscopic imaging device and would arrive at a solution which offers reduced measurement times.

1.4 Furthermore, the subject-matter of **claim 11** is also not novel over document **D7** (=US-A-5867604) (Art. 33(2) PCT), because **D7** discloses a microscope (figures 2 and 4, col. 13, line 45 to col. 14, line 21), comprising:-

- illumination means 12, 14, 16, 18, 20 for illuminating a specimen 22 with a temporally modulating, spatially periodic illumination pattern;
- imaging means 18, 20, 26 for imaging said specimen 22 on a conjugate image plane;
- acquisition means 30 for acquiring a plurality of signals at respective positions on said image plane, each signal corresponding to the incident light intensity at that position and having an oscillatory component caused by the modulating illumination pattern (Equation 28); and
- processor means 28 for measuring a characteristic of the oscillatory component of each of the signals, whereby the measured characteristics when combined in their relative positions generate an optically sectioned image of the specimen (col. 10, line 6 to col. 11, line 49).

Thus, also the microscope of **D7** has all the technical features recited by present **claim 11** (Art. 33(2) PCT).

1.5 The subject-matter of **claim 1** corresponds in terms of method steps to that of **claim 11**. The objection raised in respect of this latter claim, therefore, also apply, mutatis mutandis, to **claim 1** which thus lacks novelty of its subject-matter for the similar reasons already set out above.

1.6 Moreover, the subject-matter of method **claim 10** repeats also the operation of the microscopy imaging apparatus of **claim 11**. Therefore, the same objections as mentioned above in sections 2.1 and 2.2 arise against this claim.

1.7 Dependent claims:

Dependent **claims 2-9** and **12-20** do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step. In particular:-

- | | |
|------------------------|--|
| Claim 2: | The measured characteristics in the signal acquired in the set-ups of either D1 or D3 is the amplitude of the intensity pattern. |
| Claims 3,12,13: | A lock-in detection with its inherent band-pass filtering is well known in the field of signal evaluation. Moreover, the signal evaluation of D3 is a particular "filter technique" designed for signals with a 120° sampling interval. |
| Claims 4, 6: | The pattern of D1 is a laterally moved fringe pattern, for instance (col. 8, line 24-27). Moreover, the mask of D3 could be construed as a fringe pattern (abstract). |
| Claims 5, 14: | From D3 it is also known that the fringe pattern is an interferometrically generated fringe pattern (abstract). |
| Claims 7, 18: | The specification of certain values for the modulation frequency does not involve an inventive step. |
| Claims 8, 9: | The incident light at the image plane is reflected or emitted by the specimen. |
| Claims 15, 16: | Array detectors like two-dimensional CCD cameras are well known in the field of image data acquisition. |
| Claim 17: | The problem of providing sufficient processing power is |

generally known in the field of image data processing. A skilled person would therefore obviously take a multi-processor platform if fast signal processing is required. Moreover, document **D4** (=EP-A-1065809) closely suggests to use a smart pixel sensor for the detection of two-dimensionally amplitude modulated signals (abstract).

Claim 19: A somehow modular solution for a concrete realisation of a microscope as known from **D1** is obvious for a skilled reader.

Claim 20: The shown set-ups are standard set-ups in the field of optical metrology.